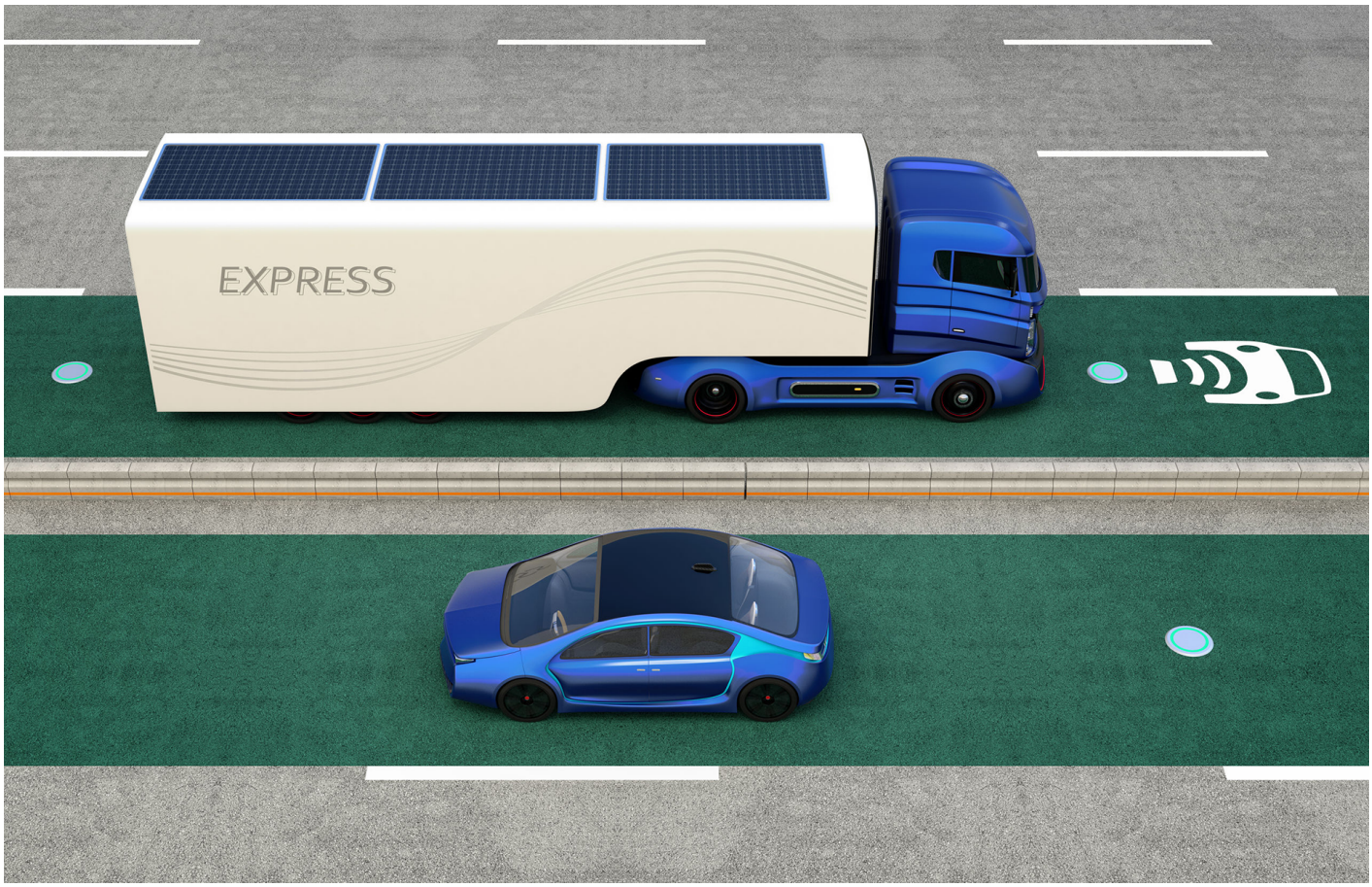
Institute for Sustainable Energy

M



Will Autonomous Vehicles be Electric?

By: Jennie Hatch (BU ISE) and John Helveston (GWU)

A recent study by researchers at BU's Institute for Sustainable Energy estimates that by 2050 the likely net increase in electricity demand from converting the light duty vehicle fleet to 85% electric and autonomous vehicles (AVs) will be between 13% to 26% of today's total electricity demand. With an increasingly green electricity mix, this could be great news for those concerned about the climate impacts of cars in general and autonomy and ride-hailing in particular.

Nevertheless, this outcome hinges on one major underlying assumption: that all AVs will also be electric vehicles (EVs).

There are many compelling reasons to assume autonomous vehicles will eventually adopt electric powertrains, and some indications point to a rosy outlook. GM's Mary Barra proclaimed her allegiance to a future with "zero crashes, zero emissions, and zero congestion." In March, Waymo announced a partnership with Jaguar's I-PACE that should bring up to 20,000 EAVs to the road in the coming years.

Yet there are also more concerning signposts. This past fall, Uber—reigning king of ride hailing companies—signed a major deal with Volvo to develop their automation software using 24,000 *gasoline-powered* autonomous Volvo SUVs. Ford also recently declared that their AVs would not be electric. If these trends continue, the much-needed transition away from carbon-intensive vehicle fuels could be even further delayed—a disastrous result for climate change.

Five reasons to expect (and push for) electric autonomy

The benefits of electric over gasoline powertrains are amplified when placed in an AV—so much so that it seems only logical that all AVs will be electric. Here's why.

Reason 1: Electrification means far less down time for maintenance. Vehicle owners usually prefer vehicles with lower maintenance needs, and this preference will only get stronger with automation. Today, most vehicles are parked 95% of the time, and even at these extremely low usage rates, regular maintenance is required to avoid breakdowns. With human drivers eliminated, AVs can operate for longer periods of time and over longer distances, leading to increased wear and tear. Simple maintenance like an oil change every 5,000 miles may suddenly become a monthly (and expensive) frustration. Especially for fleet operators (e.g., AV taxis), vehicle downtime will become an increasingly important concern. With far fewer moving parts and simpler powertrains, EVs have substantially less maintenance requirements compared to gasoline-powered vehicles, which translates into more hours on the road than in the shop.

Reason 2: Electrification is cheaper. EVs are cheaper to fuel and maintain. Over the lifetime of a vehicle, today's EVs are already on par or cheaper than their

combustion-engine counterparts, and per-mile costs will only further decline as battery costs continue to drop. Even at today's relatively low vehicle usage rates, annual maintenance costs for EVs are estimated to cost between 9% and 18% less than gasoline-powered vehicles according to a new study. These savings will be magnified as vehicle usage increases through automation, giving EVs a clear competitive advantage on price in the market.

Reason 3: It's a winning proposition for utilities. As grid loads decline due to increases in efficiency and increases in off-grid renewable energy supplies, utilities will look to EVs as a way to smooth (and increase) load. As AVs become a larger segment of the light-duty vehicle fleet, utilities can take advantage of the massive distributed battery bank in electric AVs to increase demand, balance loads, and support a more resilient electricity grid.

Reason 4: Electric charging is easier to manage without a human operator. One of the few drawbacks of EVs is that they take a long time to charge. Even using fast-charging technology, an EV can take as long as half an hour to charge to 80% of its full driving range. However, when EVs drive themselves, they can search for charging stations on their own, reducing the burden of wait time. Furthermore, the advent of wireless charging through inductive charging stations or inductive EV highways could make charging safer and more easily automated and integrated than refueling autonomous gasoline vehicles.

Reason 5: The Climate (of course). Since 2016, transportation has remained the single largest contributing sector of CO_2 emissions in the U.S. As the electricity grid continues to decarbonize, that proportion will only grow higher. Vehicle automation could create a magnifying effect in either direction through increased vehicle usage: electric AVs could facilitate the decarbonization of the transportation sector, whereas gasoline-powered AVs could exacerbate transportation-related carbon emissions.

Three reasons gasoline-powered AVs may arrive first (and stay around)

Despite the obvious benefits of electric AVs, achieving that reality may be more complicated than what the Tony Sebas of the world would like you to believe.

Reason 1: Computational Intensity. Fully autonomous vehicles are estimated to require the power of 50 to 100 laptops—about 1/10th of the size of a current Nissan Leaf battery. Range anxiety and high prices are already serious concerns for today's EVs, and adding the energy draw for AV computing power may only amplify those concerns by either reducing range or increasing costs due to larger batteries. On the other hand, AV computational efficiency is consistently improving, and with their simpler powertrains EVs may be less computationally intensive to automate than gasoline-powered vehicles.

Reason 2: Infrastructure Costs. A recent NREL study concluded that electrifying 15 million EVs by 2030 (a mere 5% of the U.S. private vehicle fleet) would require close to 5,000 fast charging station and nearly 500,000 slow charging stations. Meanwhile, nearly 300 million gasoline-powered vehicles are fueled by just 168,000 gasoline stations with an established set of behaviors and expectations (e.g., refueling in under 5 minutes). The readily-available network of refueling stations significantly lowers the barriers to the adoption of gasoline-powered over electric AVs.

Reason 3: Path Dependency. Personal vehicles are part of a complex and interconnected mobility system that involves automakers, oil companies, fueling stations, political lobbyists, and customers, among other stakeholders. With over a century of market dominance, the personal vehicle mobility system is completely centered around the internal combustion engine and the oil that fuels it. Since the upfront costs of gasoline-powered vehicles are cheaper than EVs (at least for the time being), they will likely be (and in many cases already are) the test platform of choice for developing new AV technologies. As AV technologies develop, it may be difficult to convert the systems developed for gasoline vehicles to EVs. For example, many new AV control systems are being developed using "machine learning" algorithms which require thousands (if not millions) of hours of driving time to calibrate. The lack of hours spent training in EVs (which have very different performance characteristics) may render them infeasible compared to gasoline-powered AVs. The risk of path-dependent technological development may leave electric AVs "behind the curve" against gasoline-powered AVs.

How much does Electrification Matter?

Autonomous vehicle technology can increase the overall energy consumption from vehicles through a variety of interconnected ways. For example, increased access to currently non-driving populations (such as children and the elderly) can lead to increased demand and increased congestion, reducing the overall efficiency for every vehicle on the road in terms of energy use per mile. Electrification may be one of the best ways to avoid these increases. At the ISE, we are currently examining the details of these substitutions to understand the climate change implications of further vehicle automation.

Act now, not later.

Autonomous vehicles are moving from science fiction to a very near-term reality. As of late December 2017, futurists were certain that AVs were still years away, but recent high-profile accidents offer sharp reminders that AVs are already in our midst. The time to consider the potential climate impacts of autonomous vehicles is now, and current trends indicate that a future of electric AVs is not a certainty.

One way to shape this future is to demand electric AVs be part of testing fleets. AV companies are in an all-out race to establish partnerships with cities all over the world to test their innovations and establish market dominance. In response, cities should demand that multiple different powertrains be included in AV testing to avoid path-dependent technology lock-in. By shaping the testing grounds, cities around the world can work with AV firms to steer the development path towards a more sustainable future.

Note: This article just scratches the surface on the topic of electric and autonomous vehicles. In the coming months, we will continue to address a wide variety of related issues.

Share this:

Will Autonomous Vehicles be Electric?

Posted 9 months ago *on* Monday, August 27th, 2018 *in* Blog

← View all posts

ISE Blog

Climate Communications 101: the Trusted Messenger

Electric Industry Transformation: Pathway to the “Grid of Grids”

Connect with us

Sign up to receive email updates on ISE-related research, upcoming events, and more.

Twitter

LinkedIn

Facebook

YouTube

Office Space

Boston University
Institute for Sustainable Energy
180E Riverway, 2nd Floor Boston, MA 02215
617-358-6248

Home
Collaborate
Resources
Archive